

**Fermilab**

PPD/MD/Engineering Analysis Group

**Summary of the Result for a Revised Mini 3-D Model**

Ang Lee  
10/21/2004

As discussed, a mini 3-D model has been modified slightly. It still has a symmetry boundary condition around **except one surface** as shown Figure 1. So, the structure will grow along the beam direction only. Second, instead of “no glue at all”, it is modified to have 30% area glued. The result for both tside=3 mm & trib=2 mm and tside=2 mm & trib=1.5 mm are available as following:

**Table 1 The Summary of the Calculation Result  
For t(side wall)=3 mm, t(rib)=2 mm**

	Vertical and Horizontal extrusions Fully Glued	30% area glued
<sup>(1)</sup> Deflection (mils)	1.2 (Fig_1)	2.2 (Fig_4)
Max stress (psi)	502 (Fig_2)	1,128 (Fig_5)
Max shear in the mid plane (psi)	75 (Fig_3)	245 (Fig_6)

(1) The deflection stated in the summary's table 1 is the deflection at the outer edge of the horizontal extrusion. This deflection only reflects a half structure since the center line of the vertical extrusion is fixed as a symmetry. The structure grows at both direction (see Figure 1 for the model details).

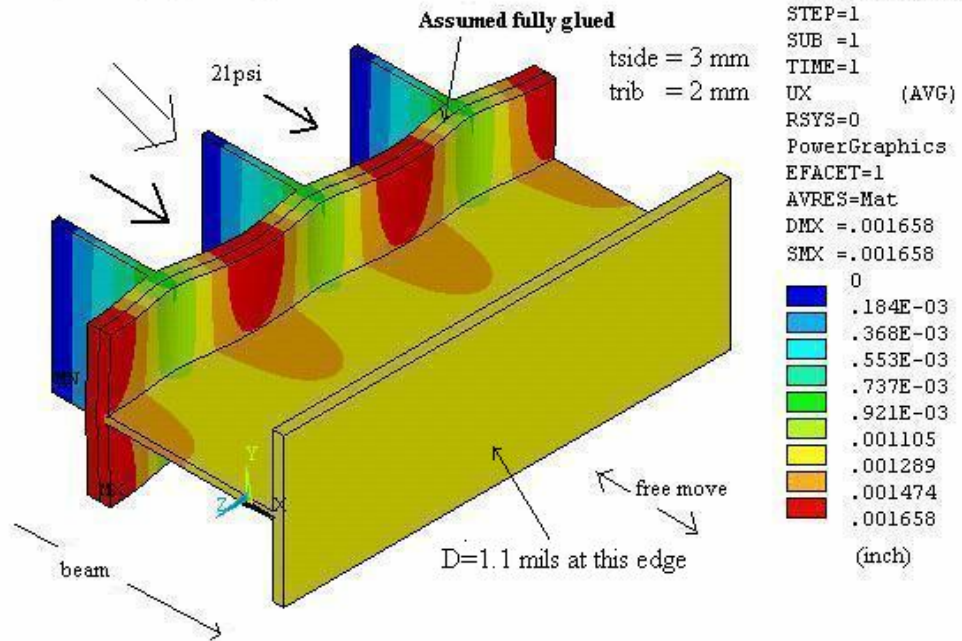
**Table 2 Result for t(side wall)=2 mm, t(rib)=1.5mm**

	Vertical and Horizontal extrusions Fully Glued	30% area glued
<sup>(1)</sup> Deflection (mils)	2 (Fig_7)	4 (Fig_10)
Max stress (psi)	800 (Fig_8)	2,105 (Fig_11)
Max shear in the mid plane ( psi)	104 (Fig_9)	361 (Fig_12)

### **Discussion**

It seems that the structure is relatively stiff. For a pair of the vertical and horizontal extrusion, it grows about  $2 \times 1.1 \text{ mils} = 2.2 \text{ mils}$  (50 micron) over 9 cm ( $2 \times 4.5 \text{ cm}$ ) for a fully glued case. For a 100 m length, one might have about 1000 paired extrusions  $100\text{m}/(2 \times 0.045)$ . It will result about  $1000 \times 2.2 \text{ mils} = 2.2 \text{ (inch)}$  over 4,000" (or 5.6 cm over 100 m long). This "structure grow" under 21 psi could become a secondary factor where compared with the tolerance built-up or the uniformity of plastic extrusion which might have an even big number.

This surface (center line of vertical extrusion) is fixed\_\_symmetry



NOVA

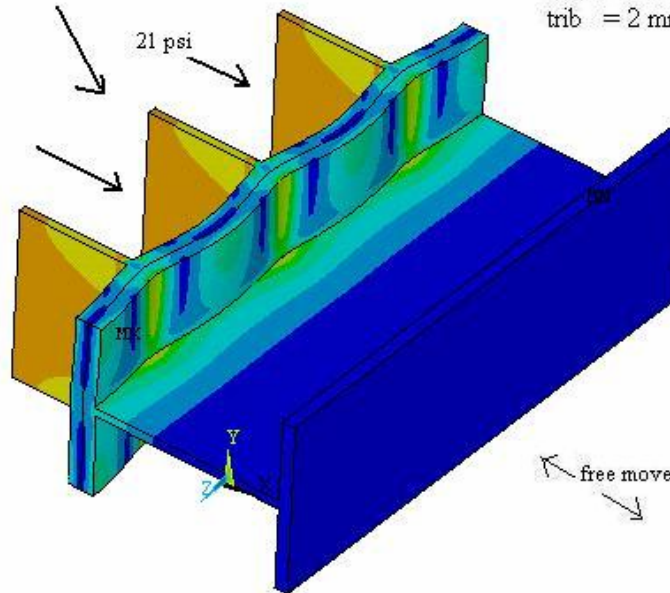
Figure 1 Deflection along the beam direction for a fully glued case

Fixed this end

21 psi

tside = 3 mm

trib = 2 mm

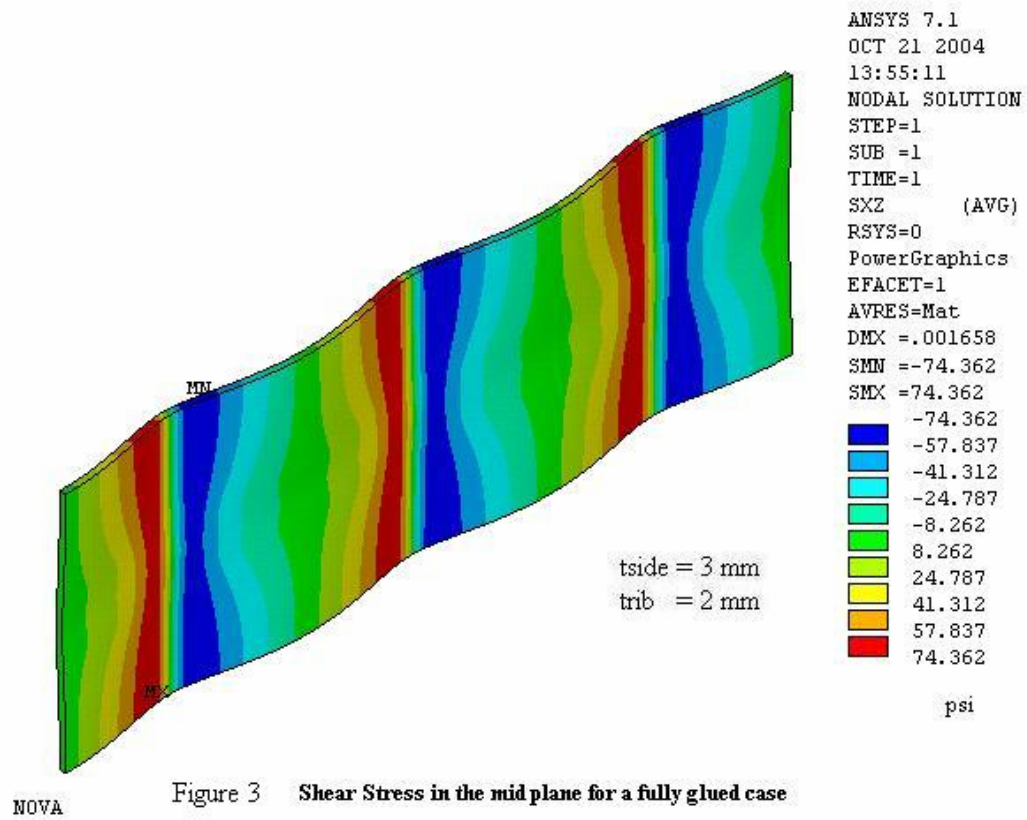


ANSYS 7.1  
 OCT 21 2004  
 13:53:50  
 NODAL SOLUTION  
 STEP=1  
 SUB =1  
 TIME=1  
 SINT (AVG)  
 PowerGraphics  
 EFACET=1  
 AVRES=Mat  
 DMX =.001658  
 SMN =.007297  
 SMX =506.02  
 .007297  
 56.231  
 112.454  
 168.678  
 224.902  
 281.125  
 337.349  
 393.572  
 449.796  
 506.02  
 psi

Figure 2

Stress for a fully glued case

NOVA



ANSYS

OCT 21 2004  
10:45:40  
NODAL SOLUTION  
STEP=1  
SUB =4  
TIME=1

UX (AVG)

RSYS=0

PowerGraphics

EFACET=1

AVRES=Mat

DMX =.003696

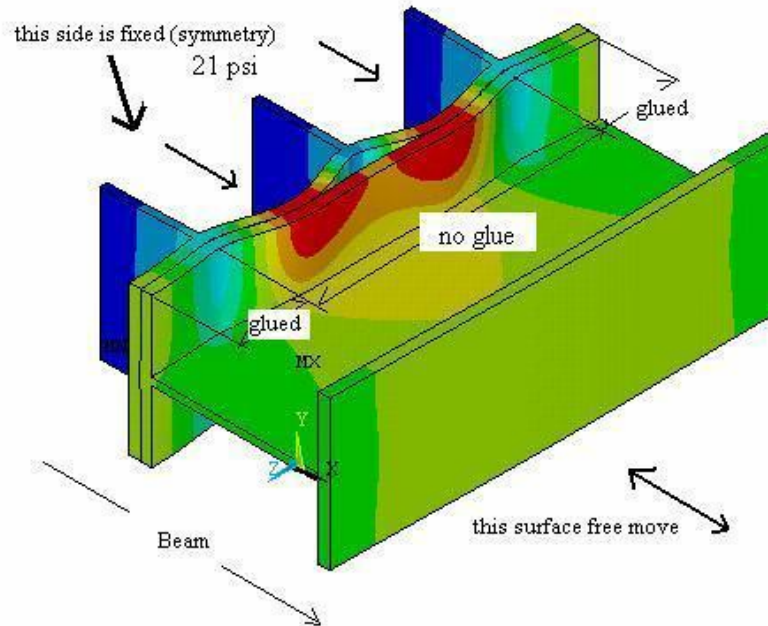
SMX =.003696

0  
.411E-03  
.821E-03  
.001232  
.001643  
.002053  
.002464  
.002874  
.003285  
.003696

inch

tside = 3 mm

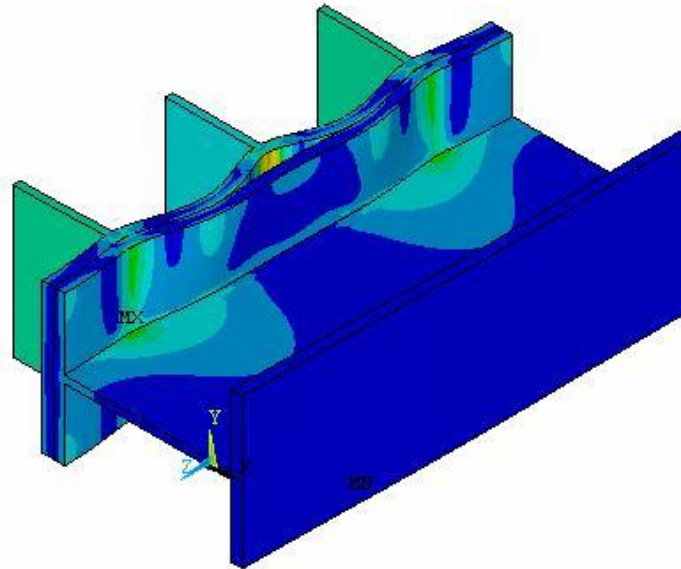
trib = 2 mm



NOVA Figure 4 Deflection along the beam direction for a partially glued case

ANSYS

OCT 21 2004  
 10:45:50  
 NODAL SOLUTION  
 STEP=1  
 SUB =4  
 TIME=1  
 SINT (AVG)  
 PowerGraphics  
 EFACET=1  
 AVRES=Mat  
 DMX =.003696  
 SMN =.608054  
 SMX =1128  
 .608054  
 125.849  
 251.09  
 376.331  
 501.571  
 626.812  
 752.053  
 877.294  
 1003  
 1128

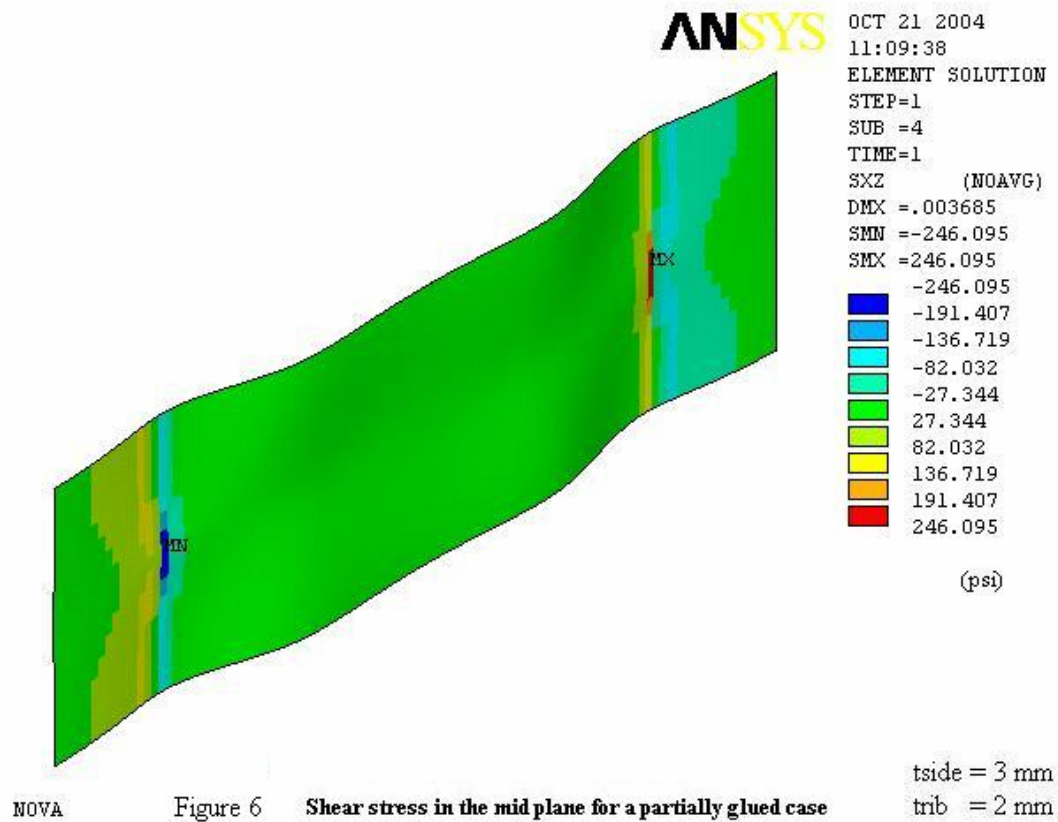


psi

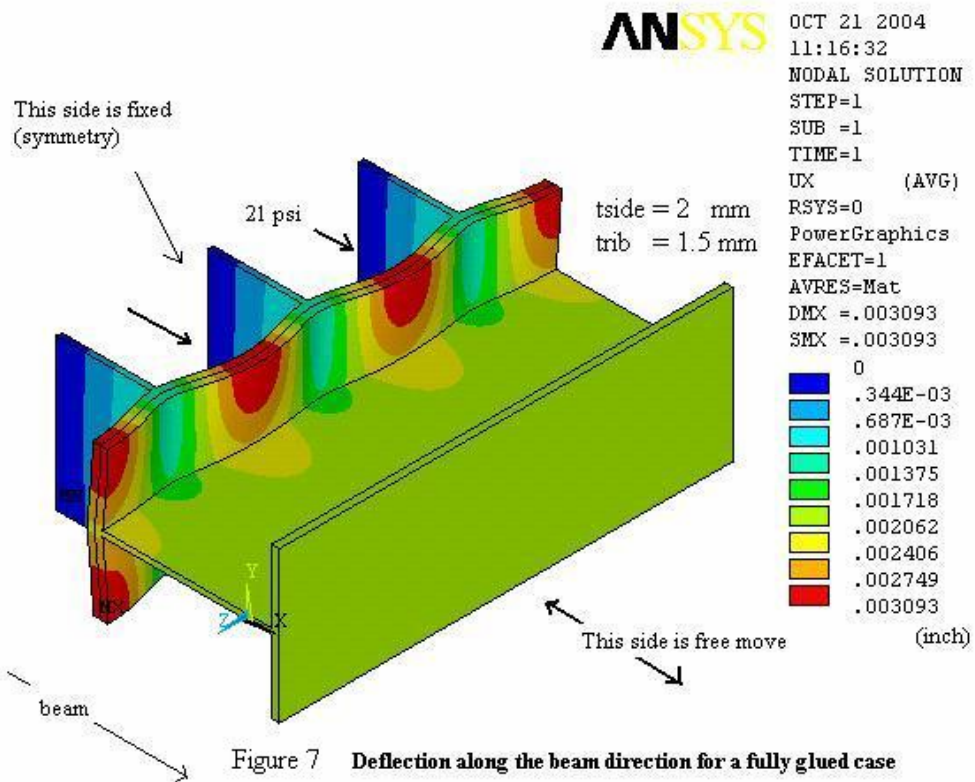
Figure 5 Stress for a partially glued case

t<sub>side</sub> = 3 mm  
 t<sub>rib</sub> = 2 mm

NOVA





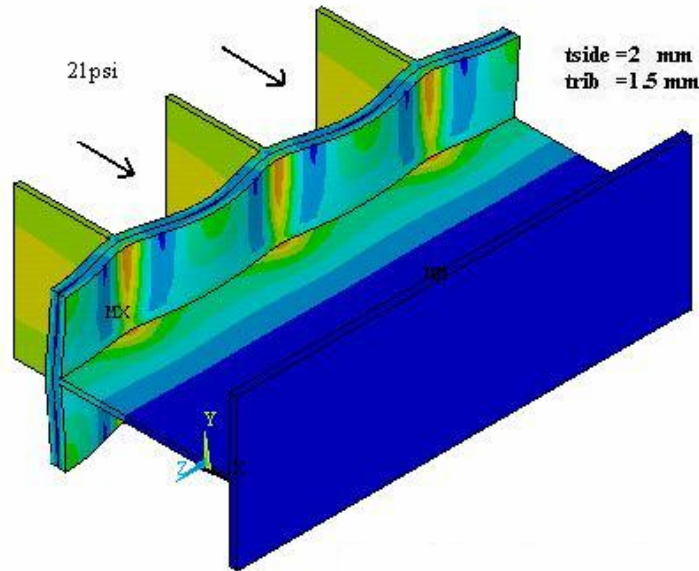


NOVA

ANSYS

OCT 21 2004  
11:17:09  
NODAL SOLUTION  
STEP=1  
SUB =1  
TIME=1  
SINT (AVG)  
PowerGraphics  
EFACET=1  
AVRES=Mat  
DMX =.003093  
SMN =.011128  
SMX =794.557  
.011128  
88.294  
176.577  
264.86  
353.142  
441.425  
529.708  
617.991  
706.274  
794.557

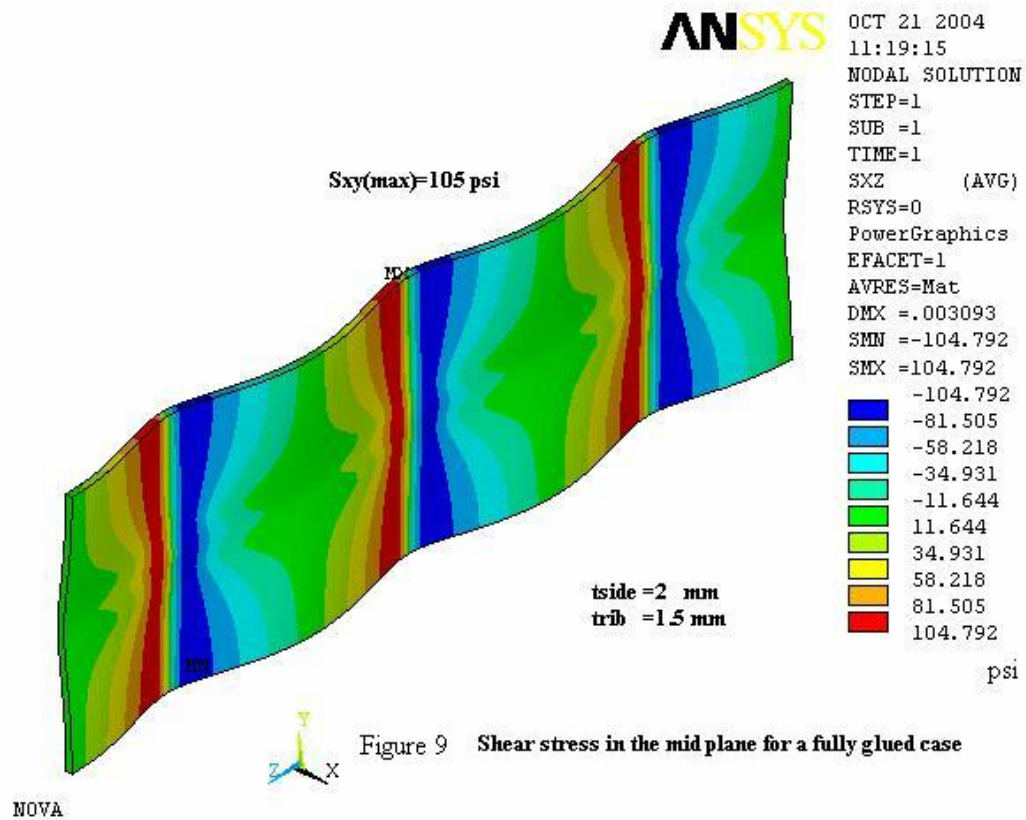
Assumed fully glued

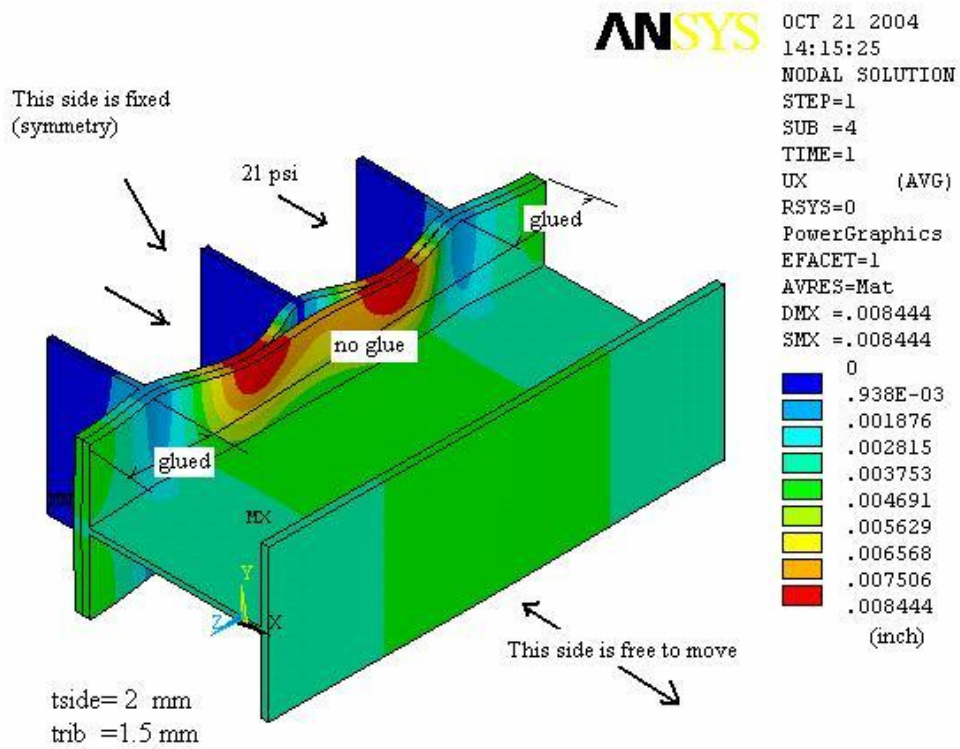


NOVA

Figure 8

Stress for a fully glued case

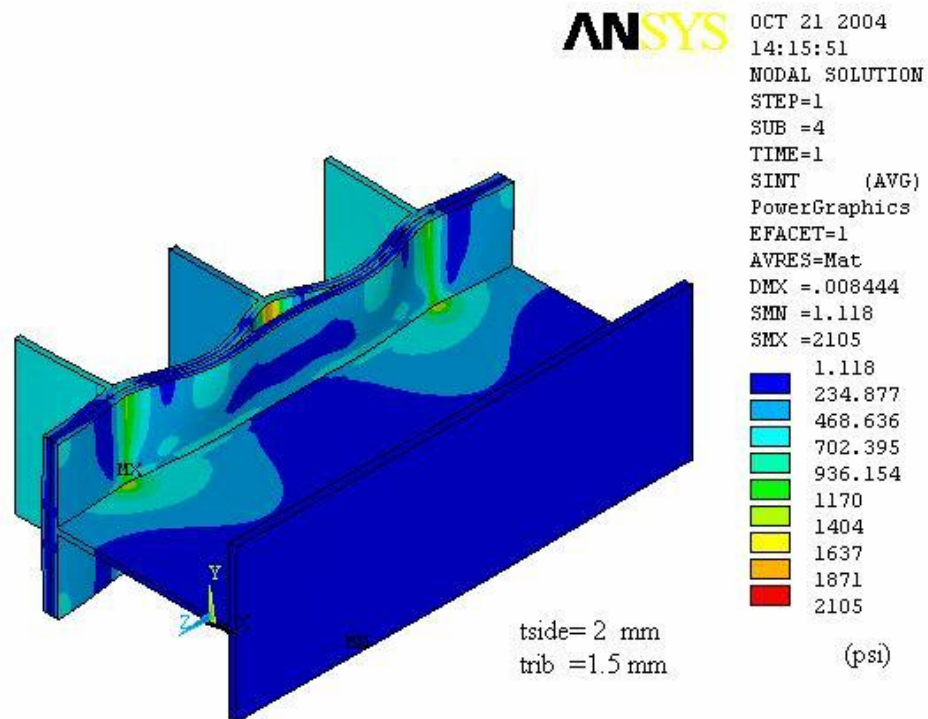




NOVA

Figure 10

Deflection along the beam direction for a partially glued case



NOVA

Figure 11 Stress for a partially glued case

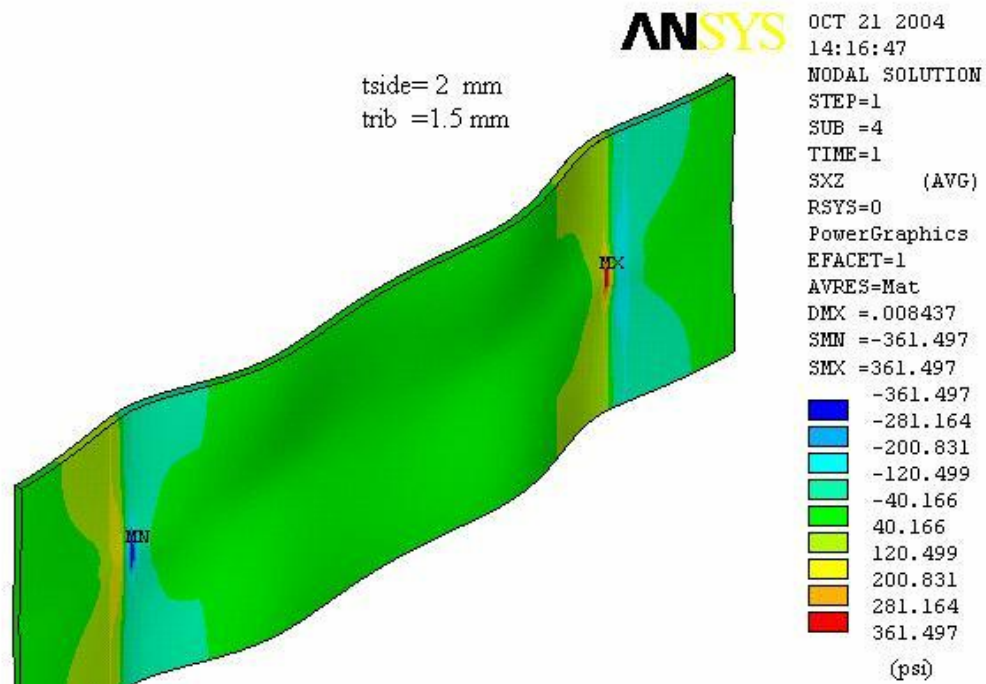


Figure 12 Shear stress in the mid plane for a partially glued case

NOVA